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ABSTRACT

Two Oregon science education programs are described following an introduction that discusses underlying problems in science education and approaches taken by exemplary practices. Exemplary practices involve the process method of instruction, teacher training, utilization of science resources outside the school, and instruction that emphasizes the interdependence of society and science. Chapter 1, "Science as a Process in the Ashland School District," describes one school district's curriculm-based approach. A science curriculum committee adapted a Rand-McNally curriculum into a program to serve the district's purposes. The document portrays curriculum implementation at an elementary school and includes evaluative statements from the principal and a third-grade teacher. Chapter 2 describes the development of a service network for fourth- through eighth-grade teachers in Lane County: the Lane Regional Science Cadre; the project focuses on teacher training. The team, which has 20 teacher members, bears the logo, "Teachers Helping Teachers." Cadre training stressed pedagogical skills, staff and organizational development, and group cohesion. The group conducted over 100 workshops during the first year; additional training occurred the following year. The document includes evaluative accounts from cadre members. Twelve references are appended. (CJH)

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Science Programs That Challenge Young Minds

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Preface

Societal changes have placed a new priority on science education. Futurists predict an increasingly complex society in which scientific and technological issues will be encountered in everyday life. Citizens will be asked to make decisions that involve complex interdependence between society and science. As the scientific literacy of citizens becomes increasingly crucial, elementary science education must respond by helping students form attitudes toward learning and problem solving that will enable them to cope with the rapidly changing world. Atittudes formed in elementary science education directly affect interest and achievement in science in middle and high schools.

This month's Bulletin begins with a discussion of the characteristics of exemplary science education programs. There is remarkable agreement among experts about the key elements of good science education programs, yet several factors lead to science being one of the most neglected curriculum areas. The Bulletin then describes two programs in Oregon that incorporate these key characteristics.

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Philip K. Piele
Executive Secretary

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Introduction

Consider these facts.

☐ Nearly 90 percent of all high school graduates are scientifically or technologically illiterate.

☐ Nine-year-olds tend to think science is interesting and fun. Student interest in science decreases, however, between the third and seventh grades and dwindles still further between the seventh and eleventh grades.

☐ More than 90 percent of teacher effort, course structure, and measured outcomes relate to academic preparation goals for the next level. Little or no attention is paid to other goal areas–those more likely to help produce scientifically literate citizens.

☐ Students are less interested in science after taking a science course than they were before enrolling in the course. The more science they complete, the greater is their disillusionment with the ultimate value of their studies.

These statistics on science education and student attitudes were reported in the National Assessment of Educational Progress, conducted in 1977 and 1982, and in Project Synthesis, organized by Norris Harms and sponsored by the National Science Foundation. The findings of these studies should make educators uncomfortable with current science education. In an increasingly scientific and technologically oriented society, the need for informed citizens is crucial. The expanding flow of information in our society demands a more informed, scientifically literate voter. The Project Synthesis group summarized the challenge:

> The responsibility is to rethink the goals of science education in light of basic education philosophy and the unique role science plays in all of our lives . . . . The goals of preparing the majority of students to use science in their everyday lives, to participate intelligently in group decisions regarding critical science-related societal issues, and to make informed decisions about potential careers in science and technology are equally as important as the goal of preparing a minority of students for more advanced coursework in science.

Underlying Problems

Several factors have contributed to the current state of science education. The most frequently cited factor is overreliance on textbooks. Over 90 percent of all science teachers use a textbook 95 percent of the time. When teachers fail to use other resources in addition to textbooks, the parameters of what students learn are restricted.

Overreliance on textbooks also suggests to students that the authors know the right answers and that all the answers are known. Students often view science as merely a set of facts to be memorized rather than as a method for exploring and understanding the world they live in. They do not come to appreciate how science affects their daily lives or that scientific methodology can be used to assist them in their own decision making.

In a recent issue of *Education Week* , Robert Rothman described a case in which overreliance on textbooks seemed to have a negative effect on student interest in science. Administrators in an Arizona junior high school allowed entering seventh graders the choice of continuing with science classes or enrolling in other courses. Ninety-six percent of the incoming students who had been in an activity-based elementary science program chose to continue taking science courses. In contrast, only 4 percent of the students who had been in textbook-oriented programs chose these science courses over other alternatives.

Inadequate teacher training is another factor that inhibits effective science education at the elementary level. Many teachers perceive that their knowledge of science is inadequate. Teachers are uneasy because they do not know all the answers. Elementary teachers who lack training in a process method of teaching will naturally feel more comfortable with a textbook approach. In addition, elementary teachers are under constant pressure to improve student achievement in reading and math and to cover a wide range of subjects in a limited time. Science is one of the first areas to be neglected when these pressures are combined with teachers' discomfort with science.

Community resources are often overlooked when a school's science curriculum is being developed. The goals of science education are often narrowly defined to a certain knowledge base, and the scope of instruction is restricted to available equipment. There is a concurrent underutilization of community resources. This approach ignores the fact that science is multidimensional, including historical, sociological, technological, and humanistic dimensions. Most schools could draw on the technology and expertise in their own communities, but barriers between community and school often cause teachers to be hesitant about utilizing such resources to enrich and expand the instructional process.

Exemplary Practices

Science education must overcome the barriers of curriculum limitations, inadequate teacher training, and lack of resources. There is remarkable convergence in the literature about exemplary science education practices. Experts agree that the curriculum and methodology employed must foster problem-solving methods, comprehension, synthesis, and creativity. Experts also agree that increased teacher training and use of community resources is essential. Use of interdisciplinary curricular methods is another common recommendation. The following paragraphs outline some of the key components of these recommendations.

Exemplary science education uses the process method of instruction. Basic science knowledge derives from direct application in an environment where students explore, offer hypotheses, and test these hypotheses. In other words, science education requires that students *do* the activities that will allow them to rearrange ideas into patterns that make sense. Students learn science concepts best by exploring, manipulating, questioning, experimenting, wondering, risking, testing, and modifying ideas. A process-oriented instructional model best facilitates this type of learning by allowing students to manipulate objects both physically and mentally.

Many elementary teachers have little training in a process method of instruction. They will need additional instruction before they attempt to implement a process-based science curriculum in the classroom. The training must be attractive and readily available to teachers.

Classroom science instruction should also relate to social issues in the local community as well as national and international communities. Local networks of educators, parents, and businesses can enrich classrooms by contributing their talent, energy, equipment, and technology. Many local science-oriented businesses are eager to share with students through field trips or guest speakers. Utilization of science resources outside the school environment helps students begin to see science as a part of their everyday lives.

It is important that science instruction begin to be presented in a social context that emphasizes the interdependence of society and science. Additionally, lack of time is a complex problem that many elementary classroom teachers face. Both of these factors can be addressed through the implementation of an interdisciplinary approach to curriculum areas that can incorporate science by either expanding cognitive awareness or extending affective learning. Science skills are augmented through a variety of applications and diverse resources. An interdisciplinary approach enables students to see how science is related to other disciplines and to society as a whole and also offers an instructional framework for cultivating the human resources society needs. An interdisciplinary approach helps students begin to see how what they learn in one subject area is related to other seemingly unrelated subjects.

The remainder of this Bulletin presents two Oregon programs that incorporate these indicators of exemplary science practices. Chapter 1 discusses a curriculum-

based model adopted and successfully implemented by the Ashland School District. Chapter 2 focuses on the Lane Regional Science Cadre, a countywide network of resources organized by staff from Lane County Educational Service District.

Chapter 1

Science as a Process in the Ashland School District

According to Ray Thiess, Oregon Department of Education science education specialist, an element key to the success of the Ashland School District's science education curriculum is the program's blend of conceptual learning with process development. In addition, Thiess points to the extensive inservice conducted by the district during the curriculum implementation process as another reason the Ashland program is so effective. This chapter describes the inservice training process and the classroom implementation of the science education program in the Ashland School District.

Development of the Science Curriculum

Five years ago, the science curriculum committee in the Ashland School District began to consider and evaluate science programs for the upcoming science adoption cycle. Marv Dunn, principal of Walker Elementary School, was the administrator assigned to chair the committee, composed of two teachers from every school in the district.

The committee started its work with a needs assessment. The material in use by the district at the time was a process method curriculum. Teachers expressed numerous concerns with the program and the materials involved, which included lots of manipulatives packaged in a science kit. The management system for the materials was poor–teachers said the materials were often jumbled in a mess or hoarded in someone's classroom.

Even though the curriculum was based on a process model of instruction, the committee decided to abandon the curriculum because of the problems teachers had encountered with the program. The prevailing sentiment was "We know it and we don't like it." In searching for a new curriculum, the committee was committed to finding a program with a strong process-oriented approach. The Ashland district's written philosophy statement for the elementary schools supported the committee's

position. As Dunn explained, the document states that experiential learning is far superior to nonexperiential learning and that quality instruction speaks to integrating rather than compartmentalizing conceptual learning. Dunn summarized the committee's position by saying that "it would have been absurd at that point to adopt something other than a process-oriented curriculum."

The committee selected Rand-McNally's SCIIS as the adopted curriculum. They felt that SCIIS was compatible with their philosophy of learning and that it had several builtin factors to ensure consistent implementation of the curriculum. SCIIS is structured in such a way that it is difficult to short-circuit or skip lessons because of the sequential and interdependent nature of the lessons. The committee hoped that this continuity of the lessons would prevent teachers from misusing the curriculum. Because science is not a popular subject area, the committee was determined to select a program that had already accounted for potential problems.

A brief description of SCIIS may be helpful at this point. SCIIS grew out of research on elementary students and science learning done in the 1960s. The research was funded by the National Science Foundation and eventually grew into a curriculum project housed at the University of California at Berkeley. SCIIS's explicit goal is scientific literacy for children. The curriculum is an integrated program that focuses on children's involvement with basic scientific concepts, process-oriented concepts, and challenging problems for investigation. The introductory unit for kindergarten leads into two six-unit sequences–a physical/earth science sequence and a life/earth science sequence.

The physical/earth sequence, which guides children through investigations of the physical world, includes the following concepts: material objects, interaction and systems, subsystems and variables, relative position and motion, energy sources, and scientific theories. The life/earth sequence focuses attention on the biological world and features the presence of live organisms in the classroom. The life sequence covers these concepts: organisms, life cycles, populations, environments, communities, and ecosystems.

SCIIS focuses on doing. Students are actively involved in observation, measurement, collection of data, organization of information, reasoning, and interpretation of information.

Teacher Training

Once SCIIS was adopted, the committee began to develop a training process that would effectively introduce and train teachers to implement SCIIS in their own classrooms. The first step occurred the year before the materials arrived. Each teacher on the adoption committee took one unit back to his or her building and then implemented the unit in his or her classroom. Building staff were invited to observe the new curriculum in action. The committee hoped to spark teachers' interest in what was to come.

Once the materials arrived, the next step of teacher training was a series of grade-level workshops. Again, teachers from the committee demonstrated a SCIIS lesson to other grade-level teachers across the district. After the lesson was taught, the teacher went on to model and explain the elements of the lesson, the patterning of the learning cycle, the materials, and the teacher's guide.

At this point, the district brought in a company representative to a general meeting of teachers. The company representative presented a traditional workshop on SCIIS that included an orientation to the materials as well as extension ideas.

The teachers were then ready to begin implementation in their own classrooms. Followup training was available. During the year, three or four additional grade-level meetings took place. Principals were also asked to allow the science committee representatives two staff meeting times to continue inservice at a building level.

The final step for the science committee was to conduct an evaluation at the end of the first year. Followup questionnaires were sent to staff meetings through the science committee. The questionnaires attempted to assess continuing inservice needs of the teachers as well as perceptions of what went right and wrong with the curriculum. The results of the questionnaire showed that the main concerns of teachers had to do with the mechanics and logistics of the program as well as with some language in the teacher's guide that was unclear. The committee developed an addendum with suggestions for responding to the identified problem areas.

Implementation at Walker Elementary School

At Walker Elementary, Marv Dunn reinforced the implementation of SCIIS by specially observing classroom instruction. He communicated his commitment to the implementation of SCIIS by saying to teachers, "I want to see it happen." For a month, Dunn observed two-to-three lessons a day. During that month, he was able to observe every teacher three or four times. Dunn felt that these observations helped to lessen teachers' initial resistance to SCIIS. Dunn also dedicated a room to large-group instruction. Teachers could use the room to do setup and cleanup at their own pace rather than being constrained by the classroom schedule.

Dunn described the first year of using SCIIS as a disaster. Delivery of their classroom organisms was the greatest difficulty. The organisms often arrived late or during vacations, and it was not uncommon for them to be dead on arrival. The second year of implementation was marked by concern over the cost of the program. The live organisms, an essential part of the curriculum, were costly.

During the third year, the district came up with an innovative solution to their organism problem. Dunn had worked with a parent who was a biologist and who was very interested in Walker's science program. The district hired this parent to grow the organisms. This reduced the cost of the program substantially and also

improved the coordination of arrival of the organisms with classroom schedules.

There have been many other positive spinoffs from this creative solution. The lab, located in one of the elementary buildings, has a huge lending library of different animals that can expand SCIIS to include other species. The lab person has also developed new units for each grade level aimed at gifted students. These new units build on SCIIS but are geared for divergent thinking.

One of the problems Dunn identified with SCIIS is the lack of builtin evaluation. SCIIS does not have an end product that can be evaluated on a test. Teachers sometimes feel that they have no concrete proof of accomplishment. Dunn would like to develop an evaluation system to document student learning, but he notes that this will take some higher-order thinking on the part of teachers. When asked to describe his perception of the results of SCIIS, Dunn responded, "I don't think there's a teacher who could deny that the interest level of students is just beyond anything else they've ever done in science."

Dunn's other goal for the future of SCIIS in the Ashland district is to make it easier for teachers to successfully implement the program. He identifies teacher inservice as the primary need at this point. The training would focus on pedagogical skills such as discussion, questioning strategies, and teaching higher-level thinking skills, which are necessary for effective implementation of the curriculum.

Observation of a Third-Grade Classroom

Pam Henningfield is a third-grade teacher at Walker Elementary School. Her classroom is filled with student excitement. Drawings of insects cover her bulletin board and, in addition to her students, the room roster includes hamsters, a newly hatched Monarch butterfly, rats, a lizard, an ant farm, and a lop-eared bunny. After school, a former student who now attends an adjacent middle school stops by to lend Henningfield his rats.

When asked about SCIIS, Henningfield's first response is, "It's a good program. I would take it over a textbook any day." Henningfield describes her students as anxious to explore, try things out, ask questions, and figure out why things work. She is a firm believer in experience. She believes her students are more curious and ask better questions because they have the experience of seeing and feeling. According to Henningfield, the hands-on experience leads her students to higher-level questions.

Henningfield says that when science is taught with a traditional text, fewer questions are asked by students because they have not had the opportunity to do such things as touch an insect's abdomen or connect batteries to a light bulb. She delights that her students "have a thousand questions that I can't answer. I see myself as a person who will help them find the answers rather than the person who is going to teach them and tell them everything."

Student interest and excitement were evident when I watched Henningfield teach a SCIIS lesson. Students were eager to interact with the materials, to make new discoveries, and to ask questions. When recess interrupted the lesson, several students wanted to stay to finish the activity. The lesson materials were left on a table so that students could continue their experimentation during free time. The only drawback appeared to be inadequate time to explore all the questions and ideas students came up with.

Henningfield's major frustration with SCIIS is that the concepts are repeated every other grade so that by fifth grade the students know and have remembered the material. She feels the program needs to be expanded at the upper level. Her other complaint, which she considers a minor one, is that sometimes the equipment sticks or is hard to use.

This year Henningfield and other teachers at Walker Elementary are developing an interdisciplinary approach to instruction. In conjunction with the other third-grade teacher, Henningfield started the year by doing an interdisciplinary unit on insects. Since Henningfield teaches science and math, she adapted and expanded the SCIIS materials for her math lessons. Insects then served as the object of study for math activities, including measuring, graphing, and story problems.

The other third-grade teacher, who teaches language arts, is also incorporating the insect theme into her lessons. Reading activities included poems, tongue twisters, and literature that feature insects. Creative writing activities include writing tongue twisters with insects and creating your own insect with habitat, life cycle, and food chain. This approach requires students to apply their science knowledge in different contexts. Henningfield holds that this integration of curricular areas makes students more aware of the reasons they need to learn the basic skills of reading and math.

Henningfield closed the interview by saying, "When I see students excited, wanting to read, wanting to have time to work, asking the kinds of questions they're asking, and using writing skills so effectively, I feel they're learning some pretty mature skills." Clearly Henningfield is enthused about the potential of an interdisciplinary approach to curriculum. Walker Principal Marv Dunn shares Henningfield's enthusiasm. He has set interdisciplinary curricular approaches as the goal for Walker school this year.

Conclusion

The Ashland School District has successfully adopted and adapted Rand-McNally's SCIIS curriculum into a science program that effectively serves the district's purposes. The careful planning, teacher training, and followup of the science committee contributed to the successful implementation of SCIIS. Teacher enthusiasm for process learning is also a critical variable in the program's success.

Chapter 2

The Lane Regional Science Cadre: Teachers Helping Teachers

The Lane Regional Science Cadre is a site-based staff development project serving fourth- through eighth-grade teachers in Lane County. The statement "Teachers Helping Teachers," which appears on the group's logo, is more than just a slogan. It is an accurate reflection of the cadre's purpose.

The cadre is composed of twenty-one top-notch teachers from twelve districts in Lane County. Providing a wide range of services, the cadre's list of accomplishments from its first year of work is impressive. Kermit Horn, staff development specialist for Lane County Educational Service District, and Ray Hull, associate professor of education at the University of Oregon, are codirectors of the cadre. They coordinate its activities and training. Horn and Hull are very enthusiastic about activities and future of the cadre.

Horn describes the development of the cadre as a cooperative effort among Lane County school districts, local industry, and higher education institutions. Horn attempted to start a consortium several years ago, but the group disbanded after six months because the timing was not right and the group was not coalescing. Horn's interest in developing such a group continued. Three years ago the State Department of Education provided the impetus for reviving the consortium concept. At a statewide meeting, Department of Education staff encouraged regional leaders to begin developing consortiums. They predicted that federal science funds would soon become available but that funding would be contingent upon having an operating consortium in the region. Encouraged by the prospect of potential funds, Horn began to organize the Lane Regional Science Consortium.

The Lane Regional Science Consortium draws its membership from local school districts, the Eugene Water and Electric Board, Lane Community College, and the University of Oregon, as well as other science-related organizations. The group meets monthly and sponsors a number of science inservice projects. The Lane Regional Science Cadre was started by this group when federal Title II funds became available. The consortium began the development of the cadre concept by looking at existing models around the state and by conducting a needs assessment

survey of Lane County teachers. Among the problems identified by this survey were outdated curriculum, lack of teacher interest, lack of teacher preparation and skill in teaching strategies, and lack of classroom emphasis on coping with science and technology in daily living.

Armed with this information on perceived needs and operating models, the consortium turned to current literature and research from a variety of disciplines to develop a model for Lane County. The *Science Education Data Book,* materials from Project Synthesis, and the *2nd International Science Study* served as a basis for identifying areas of science education in need of improvement. The emphasis on a process teaching model was strongly supported by this body of research. The consortium used the Models of Teaching developed by Bruce Joyce and Marsha Weil to provide a framework for teaching strategies. *Effective Schooling Practices: A Research Synthesis*, a booklet from the Northwest Regional Educational Laboratory, provided the consortium with guidelines on school improvement and effective schooling practices.

The last resource used was *The Handbook of Organizational Development in Schools* by Richard Schmuck and Philip Runkel. This book, which gives direction on how adults best work together effectively, provided the framework for the group process and decision-making skills that would be needed by the cadre.

The consortium blended all this information and research into a proposal for the Lane Regional Science Cadre. This proposal was presented to and approved by the curriculum coordinators from each of the sixteen school districts in Lane County. The final step involved submitting the proposal for funding: it was funded in summer 1985 by National Science Foundation grant funds.

Training of the Cadre

The cadre was ready to begin in August 1985. The first step involved the selection of cadre members. Curriculum coordinators from each district identified teachers who were doing the best job of teaching science. Of the teachers who were then interviewed by the project staff, twenty teachers representing ten of the sixteen districts were selected to form the first Lane Regional Science Cadre.

The cadre was launched with a two-week training session in mid-August. Ray Hull had written a companion grant through the University of Oregon that focused on training for cadre members. The grant was funded to train teachers to train other teachers. Hull tapped the skills of several resource people to implement the training program.

The two-week training program consisted of several important components, one of which addressed pedagogical skills. This component focused on the theory and practice of science methods and teaching strategies as well as on science content and resource knowledge. Jay Marston and Shelly Gaudia, science instructors from Lane Community College, served as science specialists for the program. Marston

and Guadia were involved with cadre training throughout the year.

Another component focused on staff and organizational development. Martha Harris, curriculum coordinator for the Eugene Public Schools, served as the cadre specialist in staff development and group dynamics. Harris coordinated this component, which included training on how to deal with the public as well as on how to provide inservice workshops.

In addition to these training strands, significant time was dedicated to the development of group cohesion. An important aspect of the process was the development of group agreements about the cadre's operation. The total group brainstormed the initial list of agreements. Each idea was then put on a form and was discussed indepth in smaller groups, which rated each idea as clearly acceptable, in need of clarification, or in need of modification. The small-group ratings were then combined. Ideas clearly acceptable to everyone became a group agreement. The other ideas were clarified and modified until they were acceptable to everyone. The agreements of the group covered release time, communications, structure of meetings, and the steering committee.

Horn described the process as time-consuming but valuable. "It took a long time to get done, but I personally believe this is the best way to run this kind of group." Horn believes the teachers' high level of commitment and sense of ownership are largely the result of the time spent establishing group cohesion and consensus. Hull likewise believes the shared decision-making structure contributes to the overall success of the cadre. Its success, he points out, is a product of effort and involvement by all members.

The last component of the training session was the formation of the training teams. Teachers worked in pairs to develop a workshop that they would offer later to other teachers based on their own interest areas. The teams developed their workshop, practiced on other cadre members, and modified their ideas in response to peer feedback. Some of the workshop topics included energy and conservation, plants and animals, astronomy, and visual activities for science.

At the end of the two-week training session the cadre was ready to begin its work. Additional training for the cadre was provided during followup activities at monthly meetings. These meetings were structured by the group agreements to encourage planning of staff development requests, debriefing and sharing experiences, organizing additional workshops, problem-solving, and continued leadership training for the group.

Accomplishments during the First Year

The list of the cadre's accomplishments during its first year of operation is remarkable. Despite the facts that each of the cadre's twenty teachers has a full-time teaching assignment and that membership in the cadre is voluntary, the cadre has

been prolific in outcome products.

During their own inservice training, cadre members decided to kick off the year with a training session for the region's other science teachers on the October inservice day. The cadre teamed up with Willamette Industry, Science, and Technology Center (WISTEC) to sponsor a miniconference. The conference included breakout sessions by cadre members, a planetarium show, as well as an opportunity to explore WISTEC. A success, the conference also served to publicize the services of the cadre.

Horn and Hull then began work on a brochure to further promote the services of the cadre and to spark the interest of teachers. They hoped teachers who needed help with teaching certain science areas would see the brochure and say,"Yes, I could use some help." Although the brochure was well-designed, it was not very successful, admits Horn, in generating interest in the services of the cadre. In retrospect, Horn attributes the lack of response to the generic nature of the brochure. Because the cadre wanted to tailor their services to the needs of the teachers at individual schools, the brochure emphasized general goals of the cadre rather than specific services.

When the cadre promoted its services in a workshop format, however, the response from teachers was very positive. In fact, the cadre conducted over 100 workshops during its first year. Each district had a contact person who approved the training for that district. Interested teachers made contact with the cadre to discuss their special interests and needs. The cadre then developed an appropriate format and conducted a two-hour onsite workshop after school.

The cadre slightly revised this format for the 1986-87 school year. Recognizing that a brief workshop is not the most effective way to initiate change in schools, this year the members added the option of an additional half day of training for teachers who are interested in pursuing implementation of workshop material. The cadre member can return to the school to demonstrate a lesson, coteach a lesson, or simply observe and provide feedback to the teacher. Again, the particular format will depend on the interests of the teachers.

In addition to the afterschool workshops, last year the cadre conducted a ten-week course that qualified for academic credit through the University of Oregon. The course was sponsored in three different districts, each of which opened the course to teachers from other districts. The format of the workshop included presentations on science content and teaching strategies, assignments for teachers to practice in their classrooms, practice teaching in the workshops, feedback from the group, and followup activities. Horn describes these ten weeks as being very effective in helping teachers develop new skills. The cadre is planning a series of one-credit sessions for this year, to be held on Thursdays after school and all day on Saturdays.

Another project of the cadre was the development of the *Lane County Science Resources Handbook for Teachers*. Based on information obtained in the needs assessment and on their own experiences, the cadre selected areas of the greatest

need and put together a collection of resources they had used and liked. The handbook begins with this statement: "Instructional support materials, people and places are vital to your confidence in teaching science."

One section of the handbook lists periodicals and organizations useful to teachers. Another section–titled "The Art of Field Tripping"–is a collection of experiences the cadre has found useful in planning successful field trips, such as site selection, pretrip classroom activities, field trip activities, followup activities, and samples of useful planning forms and letters. The handbook then lists ways to extend the science curriculum in the following areas: Astronomy and Aerospace, Geology, Human Body Systems, Nutrition, Alcohol and Drugs, Energy and Electricity, Marine Environment, and The Cell. Each section includes an extensive list of resources available to teachers, including audiovisuals, people/places/events, and books/printed materials. Finally, the handbook lists resources available from local instructional material centers and community organizations as well as state government offices and federal agencies.

In April 1986, the cadre sponsored a countywide science fair where over 200 projects were entered in the two-day event. The cadre made a videotape being used this year as a training tape for teachers working with students who are preparing exhibits. The cadre also intends to sponsor a teacher workshop in conjunction with the science fair this year. Planned as an evening event that will allow teachers to go through the exhibits, this workshop will help teachers learn how to present displays as well as expand their knowledge of science, the cadre hopes.

The cadre also produced another videotape: one evening, the cadre convened and each teacher brought a discrepant event. Horn says, "It was a fun tape to produce because we didn't know what anyone was bringing." Horn describes discrepant events as simple things that challenge one's assumptions about how things work. This tape, which can be used alone or as part of a workshop, demonstrates effective ways to pique student interest.

The last major project undertaken by the cadre during the 1985-86 school year was a science process teaching model for teachers. Horn points out that "science is the one area where we know, over time, experiential learning is best. We've evolved to a state where we know that doing–hands-on–is the best way to learn. The dilemma with this approach is that a process model takes an incredible amount of time to set up." This booklet–*Is This Model for You? The Science Experience* by Sheila Counts and others–is designed to serve as a checklist for teachers to use after they have created lessons. The booklet outlines basic elements of a science process teaching model for the preactivity, the activity, and the impact. It lists helpful hints for each step of the process as well as how and why for each element.

Teachers Helping Teachers

Karen Wildish, Al James, and Larry Marrs are second-year members of the

cadre. They share an enthusiasm for the accomplishments and for the future of the cadre. All three identified the opportunity to work with the other talented teachers on the cadre as an exciting and stimulating experience. They emphasize that the success of the cadre is due to the fact that they are teachers helping teachers.

Wildish, a fifth-grade teacher at Mt. Vernon Elementary School in Springfield, has always enjoyed teaching science in her classroom. Although she does not have an academic background in science, Wildish eagerly joined the science cadre last year. Her feelings about the cadre are overwhelmingly positive. Saying that she gets as much energy and creativity out of the group as she puts into it, she values the opportunity to get input from other teachers who are excited about science. Wildish says she often leaves cadre meetings with ten new ideas to try the next day in her classroom.

Wildish also sees the cadre as a way to accomplish more. By teaching teachers, Wildish feels she has the opportunity to influence the quality of education beyond the boundaries of her classroom. Wildish's workshop area is integrating art and science. She believes that "integration of curriculum is essential because there is no way for an elementary teacher to teach everything. Schools have to begin to integrate."

Wildish attributes the success of the cadre workshops to "the fact that we are teachers. That makes all the difference in the world." Wildish describes the cadre teachers as being very aware of the interests and time constraints of other teachers. Hence the cadre workshops make efficient use of time; they teach content and model process at the same time. The workshops also promote very usable materials, ones that are easy to acquire. Teachers leave cadre workshops with a packet in their hands that they can use the next day. Wildish hopes that the cadre concept will extend to other curricular areas because she sees the cadre as very effective at keeping teachers excited about teaching.

Al James, a teacher at Fern Ridge Middle School, shares Wildish's enthusiasm. James says that "the cadre has made me a better teacher through teaching other teachers." He believes the cadre's focus on how to teach and work with adults is as important as its focus on science content and knowledge. Describing a very positive response from other teachers, James says he receives followup calls for several weeks after a workshop. Teachers call to discuss problems in implementation of workshop ideas or to get new ideas for expanding the workshop material. Clearly teachers view the cadre workshops as a positive source of training and the cadre members as accessible resources.

The cadre is also a source of new ideas for James. He enjoys working with cadre members because of the variety of methods and styles they utilize. Cadre members bring out creativity in one another, he points out.

James's only frustration with the cadre is the lack of time to develop the good ideas that come out of the group. He would also like to see cadre members have more flexibility in delivery of services and be able to work outside of Lane County or work individually with teachers.

This past summer James was one of twenty-five teachers from the western states to attend the NASA Newmast Institute in California, a two-week long workshop he describes as a "remarkable learning experience." He believes he was selected for this honor because he is a member of the cadre.

Another cadre member, Larry Marrs, who teaches at Oaklea Middle School in Junction City, was recently named the Oregon Science Teacher of the Year for middle schools and junior highs. Marrs experiences the cadre as a valuable source of training for himself as well as a tool for dissemination of science techniques. He has personally benefitted from the great wealth of expertise members bring to the cadre and wishes more time was available for members to offer training to one another. Marrs shares the enthusiasm for "teachers helping teachers" expressed by Wildish and James.

In addition, Marrs views the consortium behind the cadre as a positive force and would like to see business and industry involvement in educational projects increase. Before joining the cadre, Marrs worked with a local utility company on an educational project and is favorably impressed by the potential of business partnerships.

Conclusion

The Lane Regional Science Cadre has successfully blended the key elements of exemplary science education into an effective site-based training model. The cadre has adopted a process method of instruction as the foundation of its workshop units. The cadre has identified local resources for teachers and made them more accessible. Both of these elements are tied together in an effective teacher training model.

Kermit Horn is excited about teachers helping teachers through the Lane Regional Science Cadre. He describes a tremendous cross-fertilization of ideas and materials as teachers work together across district boundaries. Horn believes the potential of this type of holistic approach to school improvement is still untapped. In sum, the cadre has given teachers a new way to work together and their success as a group is impressive.

Conclusion

Karen Wildish summarized the challenge in science education for elementary classroom teachers. At a conference she attended recently, Wildish learned that by the year 2000 it is predicted that 90 percent of new jobs will involve skills related to science and technology. Students entering first grade this year will be twenty one in the year 2000 and will be entering the job market. Wildish also sees the planet's environment as a major issue for these students as they begin to make decisions. It is critical, she believes, for teachers to begin to prepare students for the world they will live in.

The introduction to this Bulletin outlined the key characteristics found in science programs that will effectively prepare these students for the future. These characteristics included (1) emphasizing a process method of instruction, (2) providing teacher training, (3) integrating community resources into classroom activities, and (4) developing interdisciplinary approaches to curriculum.

Next, the Bulletin highlighted two programs that incorporated these key characteristics. The Ashland School District implemented a curriculum-based approach to improvement of its science education program, and the Lane Regional Science Cadre focuses on training for teachers. Both programs provide models for the implementation of exemplary science programs.

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